Estimating earnings forecasting models using fundamental analysis: Controlling for differences across industries

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Abstract:
Studies have consistently found that financial statement information beyond prior years' earnings is significant in explaining future earnings. A study attempts to determine if the relations between explanatory variables and earnings are stable across industries, using the explanatory variables from Ou's (1990) earnings forecasting model. The results from the analysis indicate the relations between the explanatory variables and earnings vary across industries. Controlling for these differences improves the explanatory power of the model. Industry-specific forecasting models also are estimated to illustrate how the relations between the explanatory variables and earnings vary across industry. These models indicate that, while many of the explanatory variables are significant in the model combining firms form different industries, they are not significant in the industry-specific models. The results also indicate the relations between explanatory variables and earnings vary across industry.

Full Text:

INTRODUCTION

Initial studies developing earnings forecasting models used prior years' earnings as the explanatory variables to predict future earnings. Recent studies have adopted a fundamental analysis approach, arguing that additional information in the financial statements beyond prior years' earnings is useful in predicting future firm attributes, including future earnings (Lev [1989]; Ou and Penman [1989]; Ou [1990]; Lev and Thiagarajan [1993]). These studies consistently find that financial statement information beyond prior years' earnings is significant in explaining future earnings.

One primary objective of fundamental analysis is to explain the relation between financial statement information and future firm attributes, including future earningS. The earlier earnings forecasting studies adopting the fundamental analysis approach (Ou and Penman [1989]; Ou [1990]) combined firms from many industries when estimating their earnings forecasting model. Fitting one model across firms from different industries assumes that each variable has the same effect on future earnings across industries. For example, this assumption implies that advertising expenditures have the same effect on future earnings in the retail industry as they do in the steel industry.

If the relations between the explanatory variables and earnings are not stable across industries, failure to control for these differences will result in substantial error in the forecasting model (Montgomery and Peck [1982]). These differences also will make it difficult to interpret the relations between the explanatory variables and future earnings as the relations vary across industry.

This study attempts to determine if the relations between the explanatory variables and earnings are stable across industries, using the explanatory variables from Ou's [1990] earnings forecasting model. The results from the analysis indicate the relations between the explanatory variables and earnings vary across industries. Controlling for these differences improves the explanatory power of the model.

Industry-specific forecasting models also are estimated to illustrate how the relations between the explanatory variables and earnings vary across industry. These models indicate that, while many of the explanatory variables are significant in the model combining firms from different industries, they are not significant in the industry-specific models. Also, the results indicate the relations between the explanatory variables and earnings vary across industry. These results illustrate the difficulty of interpreting the relations between the explanatory variables and future earnings, a primary objective of fundamental analysis, when the models are estimated combining firms from different industries.

IMPORTANCE OF THE STUDY

A key issue for fundamental analysis is to identify factors other than prior years' earnings that help to explain future earnings and to develop partitioning schemes that identify conditions under which measures are informative about future earnings (Ou and Penman [1992]). Ou and Penman [1992] examined many financial statement variables beyond prior years' earnings, finding only marginal improvement when a pooled sample was used. They argue that the parameters (and descriptors) might vary from industry to industry, or from firm to firm.

This study addresses the issue discussed above as financial statement variables are included in an earnings forecasting model and a small sample is partitioned by industry to determine the effects of the explanatory variables on future earnings.

FIRM VERSUS INDUSTRY-SPECIFIC FORECASTING MODELS

Accounting researchers find a relation between a firm's profitability and that of other firms in the same industry. Prior studies document a covariation among accounting numbers of firms in the same industry (Brown and Ball [1967]; Brealey [1968]; Chant [1980]; Lev [1980]). Brown and Ball [1967] and Foster [1978] found that 10-15 percent of the variability of firms' earnings was associated with the earnings of firms in the same industry. This association suggests firms' earnings are affected by factors common to an industry. These results suggest a forecasting model partitioned by industry should improve predictive performance relative to a model developed across industries.

However, Amato and Wilder [1990] also argue that the low explanatory power of their model suggests a high degree of intra-industry variation in profitability not explained by industry-specific models.1 While firm-specific models may be theoretically preferred to industry-specific models, the number of observations needed to fit an earnings forecasting model makes it difficult to develop a firmspecific model for annual earnings.

EXPLANATION OF DIFFERENCES ACROSS INDUSTRIES

Selling and Stickney [1989] argue that firms face different environments in the markets where their products compete. They argue that differences in firms' profit margin and asset turnover mix result from business strategies and microeconomic conditions. These differences result from firms pursuing different activities in response to their competitive environments. Because an earnings forecasting model including financial statement information beyond prior years' earnings captures information about firms' activities, industry-specific models should reduce model error because firms in the same industry face similar competitive environments.

Industries which require lengthy periods to increase capacity, combined with high levels of fixed capacity **costs**, operate under a capacity constraint. Firms in these industries must achieve a large profit margin to create profits since their asset turnover is limited. The large profit margin will usually be achieved through some form of entry barrier (large capital requirements, high risk level, regulation) and a minimum size required for economies of scale. Real estate, telecommunications, and oil exploration are examples of firms facing capacity constraints (Selling and Stickney [1989]).

Industries where products are commodity-like in nature, with few barriers to entry and intense competition, operate under a competitive constraint. Firms in these industries must achieve a high asset turnover to create profits since their profit margin is constrained. High asset turnover can be achieved by minimizing fixed **costs**, purchasing in sufficient quantities to realize discounts, or integrating vertically or horizontally. The actions to control **costs** are usually combined with setting low prices to gain market share and to drive marginal firms out of the market. Most retailers and wholesalers operate in this environment (Selling and Stickney [1989]).

Firms in other industries operate between these two extremes. Firms in these industries have more latitude to take actions that will increase profit margins, asset turnovers, or both in attempting to maximize their values.

Selling and Stickney's [1989] analysis supports the idea that firms in different industries face different competitive environments and adopt different business strategies. Because of these differences, the relations between earnings and firms' activities are expected to vary across industry. If the relations do vary across industry, industry-specific forecasting models should improve the explanatory power relative to a model including firms from different industries. The industry-specific models also will make it easier to interpret the relations between the financial statement variables and future earnings.

MODEL DEVELOPMENT AND STATISTICAL ANALYSIS

$$EARN_{i,t+1} = B0 + B1GWINVN_{it} + B2GWSALE_{it} + B3CHGDPS_{it} + B4GWDEP_{it} + B5GWCPX1_{it} + B6GWCPX2_{it} + B7ROR_{it} + B8CHGROR_{it} + E_{it}$$

where:

EARN = earnings before interest and taxes / total assets;
GWINVN = percentage growth in the inventory to total assets ratio;

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GWSALE = percentage growth in the net sales to total assets ratio;
CHGDPS = change in dividends per share, relative to that of the previous year;
GWDEP = percentage growth in depreciation expense;
GWCPX1 = percentage growth in the capital expenditures to total assets ratio;
GWCPX2 = GWCPX1, with a one year lag;
ROR = the accounting rate of return, i.e., income before extraordinary items divided by total owners' equity as of the beginning of the year;
CHGROR = change in ROR, relative to the previous year's ROR;
E = error term;
i = firm;
t = year;
B0 - B8 = model parameters.

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The explanatory variables for the earnings forecasting model used in the analysis are based on the model developed by Ou [1990]. These variables were selected because Ou's model outperformed the random walk model in predicting annual earnings.2 The earnings forecasting model is specified as follows:

To avoid the effects of unusual occurrences on earnings, the dependent variable for this analysis is defined as "regular income." The Financial Accounting Standards Board (FASB [1979]) defines "regular income" as sustainable or maintainable earnings, or income from continuing operations. Beaver [1981] argues that "regular income" is a good explanatory measure of the behavior of stock prices. The FASB [1979], as part of the

conceptual framework project and [1979A] as justification for disclosing holding gains and losses separate from continuing operations, recognized the need for disclosure of and research on "regular income" based on its decision-usefulness potential (Stewart [1989]).

In selecting the industries to be used in the analysis, I limited the sample to industries (defined at the four-digit SIC code) with enough firms to fit industry-specific models for short time periods. I also selected industries where most firms have one primary segment. If a firm had more than one primary segment, segment data relating to the four-digit SIC code for a specific industry were used in developing the models. The selected industries operated in different competitive environments to help determine if an industry's environment affects the relation between earnings and the explanatory variables.

Firms in the crude petroleum and natural gas industry (SIC 1311) are identified by Selling and Stickney [1989] as an example of firms facing a capacity constraint. These firms are expected to attempt to achieve a high profit margin, since their asset turnover is limited.

Firms in the eating places industry (SIC 5812) operate in the retail environment, facing a competitive constraint (Selling and Stickney [1989]). These firms are expected to adopt a **cost** leadership strategy, attempting to achieve high asset turnovers.

The strategy selected by firms in the electronic computers industry (SIC 3571) is expected to vary. Large firms focus on product innovations, so they should adopt the product differentiation strategy. Smaller firms in the industry attempt to become the low **cost** producer of clones, copying what the larger firms do. Smaller firms are expected to adopt a **cost** leadership strategy. The use of these three industries in my analysis allows me to determine if the competitive environment of an industry affects the relations between earnings and the explanatory variables.

Data were collected for all COMPUSTAT firms in these three industries from 1986 to 1988, using earnings before interest and taxes divided by total assets one year in advance as the predicted variable. This time period was selected because economic conditions were fairly stable during these three years. Also, using a three-year period reduces the effects of structural change in firms as compared to longer time periods. Reducing the effects of changes in firms across time, as well as the effects of different economic conditions, allows differences across industries to be examined.

There were 555 observations in the original sample. Each observation is one year's data for each firm. Some firms have data for all three years, while others are only included for one or two years.

Observations with missing values were deleted. A negative equity balance indicates that a firm is facing unusual circumstances, which may significantly impact the results. Since the focus of this analysis is the **prediction** of earnings for normal operating conditions, all observations with negative equity balances were deleted. The final sample consisted of 364 observations, distributed as follows:

The objective of this study is to determine if segmenting earnings forecasting models by industry reduces model error. This finding would indicate that the relations between the explanatory variables and future earnings vary across industry. The covariance (fixed effects) model for pooled regression is used to determine if industry-specific forecasting models reduce model error.

	1988	1987	1986	Total
SIC 1311	77	87	52	216
SIC 3571	18	15	9	42
SIC 5812	40	38	28	106

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The covariance model allows cross-sectional units (industries) to have a different intercept through the inclusion of dummy variables in the model. Since there are three industries in the analysis, two dummy variables are added to allow each industry to have a different intercept. Interaction terms between the two dummy variables and the eight explanatory variables also are included in the model to determine if industry-specific models would have different coefficients for the explanatory variables. The coefficients will be different if the relations between the explanatory variables and earnings vary across industry.

F_{calc} = ((SSE Reduced-SSE Full)/# of Parameters Tested)/MSE (Full).	Enlarge 200% Enlarge 400%

The hypothesis to be tested is if the relations between the explanatory variables and earnings are the same across industries. If the relations are the same, controlling for differences across industry will not significantly reduce model error. This hypothesis is tested by computing an F-test comparing the error of the full model, including the dummy variables and interaction terms, to the error of the original reduced form of the model. The F-F-test is specified as follows:

This test will determine if the hypothesis that the coefficients for the dummy variables and interaction terms in the full model are equal to zero can be rejected. If the hypothesis is rejected, the results will suggest that industry-specific models have different intercepts, different slopes, or both. This result will suggest that industry-specific models would reduce model error.

To conduct this statistical test, the following two models are developed:

1. Original reduced form of the model;

2. Full model, including two dummy variables and sixteen interaction terms.

The statistical assumptions required for a valid regression were examined for the two models. Plots of the independent variables against the EARN variable found the assumption of a linear relationship to be reasonable for both models. An examination of variance inflation factors and condition indices indicated there were no significant problems with collinearity among the independent variables.

The Breusch-Pagan chi-squared test for equal variances (Breusch and Pagan 1979) was used to determine if the equal variance assumption was met for the two models. The results from this analysis indicated that heteroscedasticity was a problem in both the reduced and full form of the model. The presence of unequal variances in the models, which is common when cross-sectional data are used, creates a problem in the analysis because the F-test assumes the equal variance assumption is met.

To address the problem of unequal variances, Cook's distances and plots of the residuals against the independent variables were examined to identify influential observations for the different models. The plots indicated that, while most residuals were in a similar range, several observations had very large residuals. Examining the plots indicated that these large residuals were responsible for the unequal variance problem. The square root transformation on EARN was used to attempt to solve the problem.3 While this transformation significantly reduced the problem, it was not eliminated from the models. However, the square root of EARN is used as the predicted variable for all models since it reduces the problems with unequal variances.4

Since the objective of this research is to determine if the relations between earnings and the explanatory variables in the forecasting model vary across industries for the majority of firms, the observations that still had large residuals, causing the unequal variance problems, were omitted from the statistical analysis.5

If the results indicate that the relations between the explanatory variables and earnings vary across industry, an earnings forecasting model for each industry as well as a model combining firms from the three industries will be estimated. These models will not include the dummy variables and interaction terms. The relations between the explanatory variables and earnings will be compared across the different models to illustrate how they vary across industry.

When examining the significance of the explanatory variables for the industry-specific models, all observations were included since statistical tests comparing the different industry-specific models were not being conducted. Since the industry-specific models include all observations, the unequal variance problem exists for the model of the eating places industry. White's adjustment procedure (White [1978]) will be used for this industry to provide an an unbiased estimate of the significance of the coefficients.

RESULTS OF THE ANALYSIS

The descriptive statistics for all variables are presented in Table 1. The information used in conducting the F-test for an overall industry effect is presented in Table 2. The hypothesis that the relations between the explanatory

variables and earnings are the same across industries is rejected (p-value = .00001).6 This result suggests that industry-specific forecasting models would reduce model error.

To examine the relations between the explanatory variables and earnings, the coefficients from the combined model, including firms from all three industries, were compared with the coefficients from the industry-specific models. As mentioned earlier, these models do not include the two dummy variables or sixteen interaction terms. Table 3 presents the coefficients and p-values for the combined model, as well as for each industry-specific model.

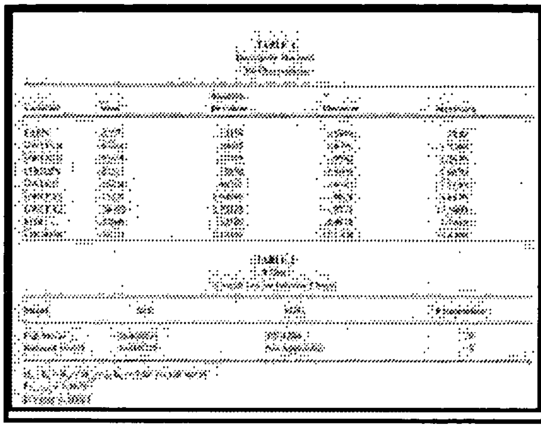

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TABLE 1
TABLE 2

Examining the industry-specific models indicates the relations between the explanatory variables and earnings vary substantially across industries. For the oil exploration industry, the GWDEP, ROR, and CHGROR variables have a significant positive relationship with earnings. The ROR and CHGROR variables have a significant positive relationship with earnings while the GWSALE variable has a significant negative relationship for the electronic computers industry. For the eating places industry, the GWINVN, GWDEP, ROR, and CHGROR variables have a significant positive relationship with earnings.

Another key result from Table 3 is that the combined model outperformed two of the three industry-specific models. This result indicates that earnings are easier to predict for some industries than for others. Thus, combining different industries in the same model will overstate the ability to predict earnings for some industries while understating the ability for others.

Table 4 summarizes the significant relations between the explanatory variables and earnings. Only the ROR and CHGROR variables are significant in all models, finding that prior years' earnings are significant in predicting earnings for all industries included in the analysis. The significance of the other variables varies substantially across industries. These differences suggest that different variables should be included in the models for the different industries.

Another interesting result from the analysis is that some of the variables were significant in the combined model but insignificant in some or all of the industryspecific models (See Table 4). The GWCPX1 and CHGDPS variables were significant in the combined model, but were insignificant in all of the industryspecific models. These relationships illustrate the difficulty of interpreting the coefficients when models are developed across industry, which is a primary objective of fundamental analysis.

The overall result from this analysis is that, to be able to interpret the relation between firms' activities and earnings, each industry should be modeled separately. The relations between the explanatory variables and earnings vary substantially across industries, so combining firms across industries in the same model can provide misleading information.

SUMMARY AND CONCLUSIONS

The objective of this research is to determine if the relations between the explanatory variables and earnings are stable across industries in a model forecasting earnings, which is implicitly assumed when models are developed cross-sectionally. The results of the analysis indicate this assumption is invalid, as the relations vary substantially across industries.

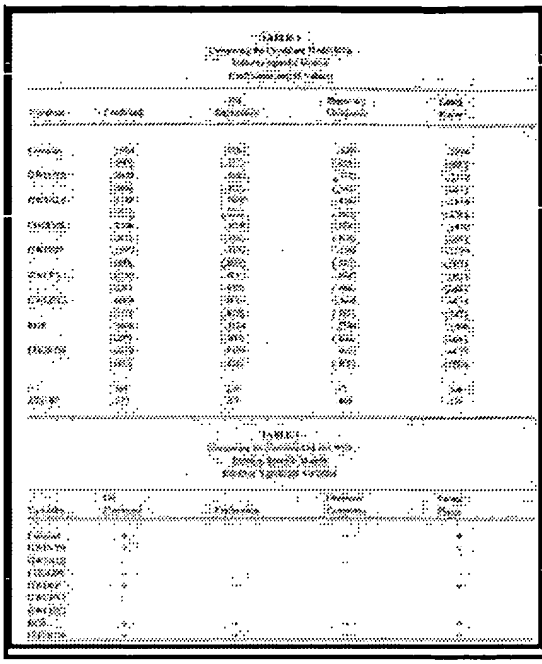

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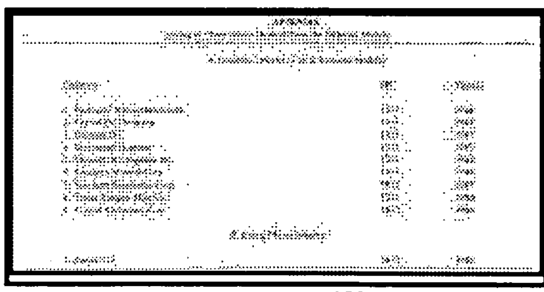
TABLE 3
TABLE 4

The results from this study illustrate the importance of considering the competitive environment in an industry when interpreting accounting information. Since the relations between the explanatory variables and earnings are different across industries, failure to account for these differences could result in information being misinterpreted.

This study illustrates that, when earnings forecasting models are developed cross-sectionally, it is impossible to interpret the relations between the explanatory variables and earnings. The results indicate that partitioning the sample by industry improves the explanatory power of the model. The partitioning also helps in interpreting the relations between the explanatory variables and earnings for specific industries.

One major limitation of this study is that it only analyzes three industries, which does not represent an adequate representation of all industries in the economy. It is possible that some industries exist that, when combined in the the same model, will improve forecast accuracy relative to industry-specific models. However, the current cross-sectional research in the literature combines firms from many different industries in the same model. Thus, the differences illustrated in this paper would affect the interpretation of the results in earlier studies.



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APPENDIX

[Footnote]
NOTES

[Footnote]
1 The degree of intra-industry variation will be a function of how industry is operationalized for empirical testing: for example, the use of four digit SIC groupings as opposed to two digit SIC grouping

[Footnote]
Ou statistically selected the variables to be included in her model based upon their relationship with the change in firms' earnings, either an increase or a decrease. However, these (or similar) variables have been used in other information content studies predicting future firm attributes, including future earnings. Also, statistically selecting the variables based on the relationship between the variables and future earnings for all firms makes it difficult to predict the relationship for specific industries.

[Footnote]
The natural log transformation also was used, but the square root transformation was more effective in reducing the problem.

For firms with negative earnings, the square root of the absolute value was taken and then the negative sign was attached.

[Footnote]
5 See the appendix for a list of the firms/years omitted from the different models.
6 The same test was used to test for changes in the relations across the three-year period from 1986 to 1988. The hypothesis of stable relations was not rejected, suggesting that the relations were fairly stable over this period. This stability allows differences across industries to be analyzed.

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